The Chemical Age

A Weekly Journal Devoted to Industrial and Engineering Chemistry

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Post-War Economic Reconstruction

DURING the depression years of the 1930's, technical men and economists alike gave much thought to the solution of the fundamental problem raised by the mechanism of industry. The potential rate of production was, and is, so far in advance of the actual rate of consumption that there was widespread unemployment of man-power, machine-power and capital. When once the material damage caused by the war has been repaired, we shall be back again in the same conditions as those of ten years ago, unless in the meantime a solution is found for the fundamental economic difficulty. Our modern economic system, though wonderfully efficient in meeting a demand for commodities, appears to be completely at sea when it has to deal with a surplus, even a relative surplus, of production or productive capacity.

In a book entitled "Remove the Shackles" (Pitman, 5s.) an American engineer, Mr. A. Grant McGregor, puts forward the thesis that the solution of the difficulty lies in increasing the purchasing power of the community by regulated and planned increases of wages and lower salaries. He, like other economists, rejects the present system of price regulation and regulation by the rates of interest on money and agrees that no adequate substitute has been found for the profit motive as an incentive to production. Similarly, Mr. McGregor maintains, and with every justification, that "bureaucracy is not only a ruinous charge on the nation but strangles competition, dams the life-stream of trade, and thus weakens the natural attraction between capital and labour, making economic and political slavery the only alternative to serious unemployment." The next stage to the present rule of bureaucracy must be the regimentation of civilian industry, as has happened in Germany, in order to deal with unemployment and price fixing and rationing. There is, unfortunately, no space here for detailed discussion of Mr. McGregory's argument, but in a few words his proposal is that when there is a tendency towards over-production and fall in prices, *wages should be raised*, not lowered, thus raising the consuming power of the nation. If, on the other hand, there is a tendency towards over-consumption and rising prices, wages should be held stationary. Consuming power must be kept in step with productive power, which in turn is always rising. Mr. McGregor's analysis leads to the conclusion that the general price-level in wholesale markets, or "prosperity level," is an index which determines the wages base for both capital and labour and that industry must be governed by a wage authority; this authority would be the Government.

Increased wages would bring about increased home prices and this under present conditions would be disastrous in the export market on the maintenance of which our economics depends. The solution Mr. McGregor proposes for this is that when British prices are raised to the prosperity level, the exchange rates of sterling should be correspondingly lowered so that the export prices to the foreigner in terms of dollars would remain constant. Thus by manipulation of the exchange rates British exports would be kept in approximate balance with imports. These proposals would thus put upon the Government the task of fixing and maintaining (1) the wages and salary level and (2) the exchange rates of sterling.

This is a serious attempt to solve the problem in economics that has so far baffled the world; and it deserves careful consideration. The first thing that strikes us is that this problem, with its sequel of unemployment, is not confined to this country alone; it is world-wide. If this solution is right for Great Britain, it is therefore also right for every other country. Will it not therefore lead to a world-wide rise of costs and wages in terms of money and thus in the end leave us no better off than we are to-day? For overseas business, the proposals are based upon the maintenance of sterling rates in terms of the dollar. Ultimately, therefore, since the same proposals should be equally valid for the U.S.A., will not the dollar itself be seeking some standard by which it can be measured? If costs rise in this way throughout all the world we shall certainly have to pay more for our raw materials and other imports; we shall also arrange to pay more for our labour, which is generally the greatest single charge in the production of any commodity.

There are some directions, moreover, in which increased purchasing power would have no effect. It is not to be supposed, for example, that increased purchasing power would lead to any considerable increase in the quantity of food required, since people can only eat a certain amount; there might be more spent on food, but this does not necessarily increase the production of food. Yet the fact remains that there could be a great increase in world consumption by raising the standard of living. But the question stands: where can we find a solution that is based upon a genuine rise in the standard of living, unaccompanied by wasteful misuse of natural resources?

NOTES AND COMMENTS

The Chemical Society's Centenary

ON Sunday, March 30, 1941, the Chemical Society reached its hundredth anniversary, an auspicious occasion marked for the time being by no more than a modest luncheon and the customary annual general meeting (last Thursday). Arrangements for the celebration of the centenary are held over until after the war. It is a matter of interest and no little significance that the new President, Professor J. C. Philip, O.B.E., F.R.S., is also President of the Society of Chemical Industry, and his joint tenure of the two appointments affords yet another link between pure and industrial chemistry, although Professor Philip has always been the first to disclaim any special knowledge of the industrial side of the science. Still, there can be no doubt that his intimate connection with the world of industrial chemists—now of two years' duration—has given him a thorough appreciation of their point of view. We do not imply that the Chemical Society has maintained an austere attitude of academic aloofness, for this would be far from the truth, especially in reference to recent years; indeed, the retiring President, Sir Robert Robinson, was himself associated for some time with chemical industry in the capacity of Director of Research to the British Dyestuffs Corporation. Although the Chemical Society is the junior among the learned societies accommodated within the walls of Burlington House, its hundred years of history display a record of brilliant scientific achievement. The exigencies of war oblige us to omit all attempt to catalogue the names and feats of its present-day Fellows just as a kindred necessity has compelled the temporary removal of the portraits and busts of their predecessors from their familiar places in the Society's rooms.

Fire Prevention

AS a result of consultations between the Ministry of Home Security and representatives of the Trade Unions and the Employers' organisations, a memorandum concerning the Fire Prevention (Business Premises) Order is to be circulated as rapidly as possible to members of those bodies. Misunderstandings, hitherto interfering with the effectiveness of the Order, should now be cleared up. Among the points dealt with in the memorandum is the necessity for the occupiers of business premises to consult persons working on those premises before making arrangements for the execution of the Order. Existing agreements for the employment, on a voluntary basis, of either part-time or whole-time fire-prevention personnel, on appropriate terms and conditions, will not be disturbed. Nor are out-of-pocket expenses, etc., ruled out by the article of the Order, which provides that no person shall be entitled to any remuneration for fire-prevention duties outside his working hours. Such matters should be arranged between the parties concerned. Reference is also made to the special provisions needed to deal with cases where there is a deliberate evasion of the Order. Copies of the memorandum will be supplied free of charge by the Publications Dept., Ministry of Home Security, Horseferry House, Thorney Street, London, S.W.1.

War Damage Act

DETAILS were announced on March 28 of the new war damage insurance scheme, reported in our last issue, under which manufacturers and traders will be able to insure their plant, machinery and business equipment. THE CHEMICAL AGE understands that the scheme will probably come into force soon after Easter. Those affected by the scheme are advised to do nothing until the Board of Trade announces the date on which the scheme comes into force. Then, in order to be covered, it will be necessary to insure within 30 days from that date. The scheme will be operated by the Board of Trade through certain insurance companies and Lloyds as their agents. Full information will be obtainable from the broker, agent or company effecting the insurance. The period to be covered is from the beginning of the war to September 30, 1941, and the rate of premium will be 30s. per cent. To cover this period, three policies at 10s. per cent. will be issued. The Liability for War Damage (Miscellaneous Provisions) Act, 1939, requires that insurance be effected for the full value of the plant, machinery, etc., and manufacturers and traders would as a rule be well advised to insure for what it would cost them to replace the goods at the time of loss, less a reasonable amount for depreciation. It is necessary to allow for depreciation because the Government cannot be expected to give new equipment for old. It is recognised that it may be difficult to apply this basis of value and the Board of Trade would be ready to consider any cases of special difficulty with a view to arriving at a satisfactory basis. Such cases should preferably be brought to their notice, or at least supported by, a responsible organisation able to speak for the industry as a whole.

Method of Obtaining Compensation

THE War Damage Act provides for those cases in which damage was sustained before the proposed scheme comes into force. If property has sustained war damage at any time between September 3, 1939, and the date to be announced for the coming into force of the scheme, the effect would be the same as if a policy had been taken out under the scheme and compensation will be paid at the same rate. A sum will be deducted from the compensation, however, to cover any premium which would have been paid had the scheme been in force. If Form V.O.W.1 has been filled in, nothing more need be done unless instructions to the contrary are received from the Board of Trade. If it is necessary to fill in another form or supply further information, the Board of Trade will make an announcement which will be given wide publicity. If war damage has already been sustained and Form V.O.W.1 has not been filled in, a copy should be obtained from the office of the local authority without delay. Generally speaking, payment of compensation will be deferred until after the war and interest on the amount due will accrue at the rate of 2½ per cent. from the date of the damage, but will not be paid until the final settlement. Earlier payment, either in whole or in part, may be made, however, if the amount of the claim does not exceed £100, or if the Board of Trade is satisfied that the replacement is in the public interest.

Concentration—Voluntary or Compulsory?

THE serious disquiet felt by large sections of the business community with the Government policy for the concentration of industry was not sensibly relieved by Mr. Oliver Lyttelton's latest exposition of his scheme. The Minister, for example, was at great pains to assure the small man that the scheme was not directed against him. Unofficial speakers in the debate, however, held that there was no effective safeguard for the small firm or for the worker or for the consumer. Mr. Shinwell even declared that the scheme sounded the death-knell of small firms. Mr. Lyttelton agreed that an eye must be kept on the change-over from war to peace, and that is indeed the crux of the problem. Unfortunately, his suggestion for the revival of businesses closed under the war concentration scheme was unhelpful where it was not vague. He talked ominously of the continuance of Government control for some time after the war. It is the inherent difficulty of all these schemes for the bureaucratisation of industry, that there is never any obvious point at which you can make a clean cut with them. Mr. Lyttelton was anxious to encourage not only the linking up of factories, but the grouping of shops. If one thing is plainer than another in the hazardous course that he is taking, it is that any attempt a compulsion would produce harsh injustice and a hopeless muddle generally. Such steps as have been taken so far have been purely voluntary within certain of the specified trades. Under such a voluntary operation it ought to be possible to secure the release of needed labour for munition work, but anything like a threat of compulsion and an influx of officialdom would defeat the very purpose which Mr. Lyttelton has in view.

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THE CHEMISTRY OF COFFEE

Preparation of the Commercial Product

by FRANCIS G. H. TATE, F.I.C.

THERE is probably no article of human consumption which, during its preparation, emits an aroma so appealing to the average Briton as coffee. No article occupies a position more unassailable in the dietary of the gourmet, and, in spite of its partial replacement by tea as a popular beverage, there is no satisfactory substitute for it as the accompaniment to the post-prandial liqueur. It is not only as a pleasing finale to a good meal, however, that coffee is of service to mankind. It is a valuable stimulant, energising the wearied brain, reviving the tired heart, and dissipating depression. On the other hand, there is no potable article which demands greater care in production and preparation to ensure that the resultant product shall give a full measure of satisfaction.

While possibly there are many species of the natural order *Cinchonaceæ*, which occasionally are cultivated for the production of commercial coffee, there are two—*Caffea arabica* and *C. paniculata*—most usually accepted as the trees from which the best product is obtained. There are, of course, various types of these depending upon geographical considerations and the methods of cultivation. The resultant berries display considerable variation, not only in flavour, but also in physical condition, by which they can be recognised. Thus Mocha or Arabian coffee usually has a single-seeded berry; the Jamaican variety is nearly always a double seed; the East Indian berry is very small; while the indigenous African berry is large and coarse; but careful grafting and cultivation has, in recent years, effected considerable improvement and resulted in a much favoured product.

Favourable Soils

The method of cultivation depends in great measure upon natural conditions of climate and soil. The mean temperature should be not less than about 70° F. Thus there is a wide belt on each side of the Equator in which may be found land suitable for cultivation. A rich soil, which can be improved by fertilisation with potash, phosphate, and bone meal, is desirable, with a light subsoil affording efficient drainage. It has been found that in sand cultures the best result is obtained at *p*H 6.5-7.5, the growth being considerably decreased at *p*H 6.0. Vegetable mulches for the improvement of the soil have been tried with good effect, one of the most satisfactory being dried banana leaves, which have a high nitrate value, conserve the moisture, and maintain an even temperature in the soil. The young plants which may, in the first instance, be reared from seed under cover or selected from old plantations, vary in age from six months to two years at the time of transplantation, but it is not until they are about four years old that they produce a satisfactory yield of fruit. Thence onwards for several years they will, with careful attention, continue to yield almost continuously. The fruit consists of an outer skin containing a glutinous pulp in which are the beans. These may be double, in which case they lie face to face, or single. The bean is enclosed in two membranes, the outer, technically known as the "parchment," which, on drying, is readily separated by rubbing or trituration; and the inner "silver skin," which adheres so closely to the bean that some always remains present even after roasting. Its spindle-shaped cells, peculiar to coffee, form a useful means of identification under the microscope. The process of harvesting may have an important effect upon the ultimate flavour, and the method of subjecting the beans to the heat of the sun for three or four weeks is now replaced by application of artificial heat, thus expediting the process and preventing the disagreeable flavour sometimes caused by putrefaction of the pulp.

The process that is of the most vital importance in producing the characteristic aroma and flavour of good coffee is the roasting of the bean. The temperature is important, about 200° C., or a little over, being the most favourable for affording the best result. A lower temperature does not develop the aroma and the bean is not sufficiently brittle for effective grinding, while excessive heat imparts a nauseous flavour to the product. During roasting the outer portion of the bean is subjected to oxidation, but reverse conditions probably obtain in the interior. The resultant effect, therefore, is complicated and liable to considerable variation, and a corresponding multiplicity of contending theories has been advanced in explanation. The weight lost in roasting represents from one-sixth to one-quarter of that of the unroasted bean. Water to the extent of 7 or 8 per cent. is first driven off, followed by carbon dioxide and other volatile products. These are possibly the result of what has been described as a certain process of destructive distillation accompanied by dehydration and polymerisation. In confirmation of this it has been found that 10 kg. of coffee beans yield on roasting about one litre of liquid containing caffeine, caffeol, and other substances, which together might explain the fragrant coffee-like odour of the liquid. In addition, there is in suspension in the liquid a certain amount of solid matter consisting chiefly of palmitic acid. On the other hand, it has been suggested that there is no appreciable dissipation of the constituents of the bean, the roasting simply transforming some of these into substances which contribute to the fragrant aroma of the roasted product.

Importance of the Fatty Constituents

Consideration of the various theories has been taken to indicate that in all probability the greatest change takes place in the fatty constituents. When extracted directly from the raw bean the fat is white, inodorous, and of the consistency of butter. While its composition shows wide variation, it contains approximately 30 per cent. linoleic acid, 20 per cent. palmitic acid, and rather less carnaubic acid. The fat content of the bean varies from 6 to 20 per cent., and the fact that the latter proportion has been found in the finest Mocha coffee appears to support the theory that the composition of the fat after roasting is closely related to the flavour of the final product. In this connection it is interesting to note that the "staling" or deterioration of the bean, particularly if the latter is ground, has been attributed to the oxidation of the oil or fat, and that if the oil is extracted from stale coffee it has a rancid disagreeable flavour quite different from that of the oil obtained from the fresh bean.

In opposition to this theory, certain American investigators claim that the staling is directly concerned with changes in the volatile aromatic ingredients and is not connected with fat rancidity. The truth probably lies between the two theories, the aroma being due to a combination of substances such as caffeol, quinol, and methylamine, the satisfying effects of which are disturbed when fatty acids are liberated as the result of spontaneous saponification.

The Caffeine Content

The ingredient substance most popularly associated with coffee is caffeine, and it is interesting to observe that it is present under the title "theine" in tea, while the third popular beverage of the same class, cocoa, contains another alkaloid, theobromine, which is closely related to caffeine. The exact condition in which the caffeine occurs in the original bean has been the subject of considerable discussion, but the consensus of opinion is that it is in a state of combination possibly as a tannate or as a chlorogenate. The proportion present varies from a negligible amount to over

2 per cent. in the natural product, but the public demand for coffee of low caffeine content has accounted for a reduction in the average proportion found in the commercial product. How far this demand is justified is problematical. There is no doubt that the stimulating effect of coffee on the heart and also on certain digestive processes is due to some extent to the presence of caffeine, but in excess this may have an adverse effect on the human organism. Whatever may be the basis for the demand, however, it undoubtedly exists, and to meet it two lines of research have been followed, viz., the natural production of a bean with low caffeine content and the treatment of the bean for the removal of caffeine at some stage in its preparation.

Decaffeinisation

Although caffeine-free coffee has been found in nature, the flavour is generally considered to be inferior to that of the fruit containing caffeine. Consequently, the treatment of the latter is now generally adopted commercially, and if the final product possesses unimpaired the desired flavour and aroma, this appears to be the better course. The so-called "decaffeinised" coffee is not necessarily entirely free of caffeine, and it may contain as much as 1 per cent. The basis of all processes of decaffeinisation is extraction either with water or an organic solvent. In the former the water may be used alone, made alkaline, or have in solution sugar or some other substance in order to effect the selective removal of the caffeine from the beans.

In the case of organic extraction the solvent may be a single substance such as benzene, toluene, or chloroform, or two or more may be used in rotation; or, again, an emulsion may be formed with benzene or chloroform and water. The extraction takes place under pressure, or the beans are crushed, rolled, or steam-heated to facilitate extraction. The treated beans can be freed of last traces of the solvent by subjecting them to a passage of hot air or steam. Another method of decaffeinisation is to subject the beans to very drastic extraction, the caffeine being then separated from the extract which is returned to the beans by spraying. As an alternative to extraction of caffeine from the beans, it is claimed that infusion of coffee can be decaffeinised by passing it through charcoal or silica gel.

Whilst, owing to caramelisation, there is practically no sugar in roasted coffee, the raw bean displays considerable variation in saccharine content. Sucrose, with some invert sugar, has, on occasion, been isolated, but some workers have been able to find only a glucoside present.

The hygroscopic character of the dried bean is of interest to the trade and also to the consumer. The normal proportion of moisture is about 11 per cent., but is greatly affected by the humidity of the atmosphere. It has been found that paper or parchment wrappers impregnated with a preparation of oat flour have a valuable preservative effect.

Adulterants

The addition of chicory to coffee, although possibly a form of adulteration, is now so generally recognised and in accordance with a limited public taste that it may be accepted as quite legitimate if the mixture is offered for sale as such. Botanically, indeed, chicory is far removed from coffee, but after roasting, the caramelised sugar, of which the chicory contains a high proportion, imparts to the infusion a deep brown colour, which, combined with its aroma and bitter taste, gives it a close resemblance to coffee. Furthermore, it has been claimed that the soluble constituents of the chicory interact with the caffeol of the coffee to retain the latter in the infusion.

The addition of other substances to coffee must definitely be regarded as adulteration. In Britain this practice may now be considered to be non-existent, but it is very common in some other countries, and the number and variety of the adulterants are almost unlimited. The nature of the adulterant depends upon the purpose for which it is added. Thus an increase in bulk is achieved by adding maize or some other cereal, fruit, as for example figs, or various dried roots such as parsnips and beets. To improve the appearance various inorganic colouring substances and dyestuffs are introduced, while albumen, glucose, shellac, or borax, are used to glaze the beans. In order to retain the moisture in the beans and thus increase the weight, glycerine or even a mineral oil have been used.

Closely identified with the question of adulteration is the use of imitations or substitutes; this again is little practised in Britain, although abroad it is not uncommon. The substances prepared are many and, in addition to chicory, include most of those already mentioned as possible adulterants. If the substitute is offered for sale as such, no objection can be raised, but imitation beans, which might deceive the purchaser, are sometimes prepared by moulding the substance into the shape of coffee beans with the aid of some adhesive material such as gum.

As already stated, however, adulteration and substitution are very rarely practised in this country. The fragrant cup may well be accepted here with a confidence equal to the pleasure which it invariably brings to those who, after the satisfaction of a good meal, may be enjoying pleasing conversation or solitary reverie.

Chemists and the Central Register

B.A.C. Demands a Revision of the Machinery

THE British Association of Chemists expresses itself as not entirely satisfied that full use is being made of the Central Register as far as its chemical personnel is concerned. Before war broke out, the B.A.C. was concerned, with other chemical societies, in supplying particulars for the formation of a register of qualified chemists of which use could be made in any emergency. It was assumed by the Council that together with other chemical societies the Association would be represented upon any advisory committee formed to deal with the operation of this section of the Central Register. Up to the present, it appears that nominations to the advisory committee have been made upon an individual basis. Since the authorities concerned originally approached the professional societies as such, it is the Association's view that the composition of the committee should have been organised on the same basis.

Having regard to the Ministry of Labour's general policy for more complete organisation of man-power, the machinery in use for the operation of the technical section of the register should be reviewed. The B.A.C. hopes that the co-operation voluntarily offered to the Government before the outbreak of war may now be utilised fully as far as the chemical societies are concerned.

Legal Advice for Chemists

Service Agreements and the War

WAR conditions introduce special problems in connection with service agreements and conditions of employment for chemists. Examples of this are the manner in which conditions of service are affected if the employer's premises are damaged by enemy action, and the extent to which such damage affects members of the staff who have contracts of service with the company concerned.

In the present circumstances it is natural that chemists may well require advice in matters of this kind, and the Legal Aid Department of the B.A.C. has been able to assist members with such advice. By reason of the long experience of the Association's Legal Aid Department in connection with service agreements the advice it is able to give is of a highly specialised character. Members are therefore in a particularly favourable position to secure authoritative information concerning their legal standing in circumstances of this kind. The work of the Legal Aid Department, always an important part of the Association's activities, is now more than ever essential to professional chemists.

British Standards in War Time

Close Contact with State Departments

SOME months before the outbreak of war the British Standards Institution, which is the recognised centre for the promulgation of all national British Standards, offered H.M. Government the services of the Institution, as a complete unit, in the national emergency. This offer, which was sent to the Board of Trade through whom the B.S.I. receives its government grant, was most cordially received and the various departments of State were duly informed of the proposal. On the outbreak of war the B.S.I. realised that its peace-time procedure was inadequate to deal effectively with the demands imposed by the changed conditions, and especially by the need for rapid action. A number of small executive committees were therefore set up for the various sections of its work, these being made fully responsible for the preparation of any war emergency specifications the Institution might be called upon to undertake. Under this emergency procedure the executive committees were given authority to restrict the usual wide consultation of industry to those interests directly concerned, and the reduction of the time usually given for comment on draft standards. It is, of course, understood that any British Standards issued under war-time procedure will come under review as soon as peace comes again.

Government departments are employing the B.S.I. machinery for the preparation, co-ordination, and promulgation of war emergency specifications to meet their several requirements, that policy being adopted because of the great experience of the Institution in this field and because it provides a most effective liaison between them and almost all branches of British industry. The B.S.I. is invited to send a representative to appropriate meetings of the Materials Committee of the Production Executive, which is representative of all Government Departments, the Central Priority Department acting as the liaison between that committee and the Institution. This has brought the B.S.I. into close contact with the increasing number of departments working to specifications, and is thereby bringing about a considerable measure of co-ordination in their preparation and issue.

Important Economies Effected

As an indication of the value of the work of the B.S.I. it may be mentioned that the first issue of the War Emergency Specifications for Tins and Cans for food products and other commodities is estimated to have saved 40,000 tons of steel in the first year. The British Standards, specifically mentioned in the Government Order, have been issued with the approval of the Minister of Supply following the recommendations of the Economy Committees set up by the Materials Committee. The B.S.I., in collaboration with the appropriate branches of industry, has been entrusted with the task of making recommendations in the first instance to the above Economy Committees in connection with tinplate containers. The work is being extended to cover packaging generally and has involved already the formation of more than 80 committees.

A further example of the employment of the B.S.I. by the Ministry in effecting saving of material is the issue of a War Emergency Specification for Bolts and Nuts with smaller heads, which, it is estimated, will save many thousands of tons of steel a year. Another example of the work of the Institution is the rationalisation of alloy and special steels. A committee under the chairmanship of Dr. W. H. Hatfield, F.R.S., has for some time been engaged on an investigation of this complex matter and has drawn up a confidential report which includes suggestions for a co-ordinated series of steels. Such sections of the report as can be made available to the engineering public will shortly be issued by the B.S.I., which will at the same time issue, as complementary to the above, War Emergency British Standards covering the steels recommended in the report. The committee has most kindly placed itself at the service of the B.S.I. and is acting as its advisor in all this important work. The experience of the B.S.I. is also being drawn upon in several directions through the good offices of the Central Priority Department, where the preparation and issue of Standards may not necessarily follow.

Besides all this the Institution, in response to direct requests from industry, has prepared and issued a number of War Emergency Specifications to meet the special conditions resulting from the restriction in the supply of materials, and the demands for new and revised standards to meet these contingencies are increasing. This war work has in no way prevented the B.S.I. from maintaining its usual close relationship with the Dominions standardising bodies. Moreover, the B.S.I. Committee in the Argentine Republic, which is working in close collaboration with the IRAM, the Argentine national standards organisation, is receiving increased recognition as its work is seen to be of real value to British export trade. British engineers and traders in the Argentine are to a greater degree giving practical support to the work of the committee, and manufacturers in Great Britain have, by a farsighted policy of financial support, made that work possible. British Standards, through the work of this committee, are receiving the same consideration at the hands of the IRAM in the drawing up of Argentine standard specifications as the standards of other nations.

The B.S.I., with the help of the British Council and of industry, is also engaged in compiling a number of technical handbooks dealing with British industrial practice. The books are to be published in Spanish and Turkish and should do much to familiarise engineers and students in Turkey and the Spanish-speaking countries with British methods.

It is hoped that this brief review of the activities of the B.S.I. will be sufficient to show that the close contact maintained with the departments of State and with industry, the confidence of both of which it so largely enjoys, is enabling the British Standards Institution to contribute in substantial measure to the national war effort.

Heavy Sulphur Isotope

Experiments at Columbia University

A CONTINUOUS process for the concentration of heavy sulphur, atomic weight 34, is in operation in the Department of Chemistry at Columbia University, New York, where it has been developed by Dr. D. W. Stewart and Dr. K. Cohen. The heavy isotope occurs in nature to the extent of one part in 32 of the common isotope of atomic weight 32. In the Columbia process a sulphur is produced in which the heavy isotope exists to the extent of one part in four. Three grams a day are being produced, sufficient for a large number of nutrition experiments in which the important part played by sulphur in life-processes can be determined. The concentration process is based on the fact that the heavy isotope slightly favours the liquid compounds in a continuous exchange reaction between sulphur dioxide gas and a solution of sodium bisulphate.

INSECTICIDE CHEMICALS IN U.S.A.

According to a statement made by a representative of E.I. du Pont de Nemours and Co., the United States is now self-sufficient in the chemicals commonly used to combat insect and fungus pests. Lead arsenate, calcium arsenate, Bordeaux mixture, lime-sulphur solution, tobacco spray products, spray oils, and dust mixtures are readily procurable. The Du Pont Company operates a laboratory devoted exclusively to pest control research, and recently a synthetic product was developed as a substitute for pyrethrum, the lethal ingredient of many insect sprays. This new product may very probably replace to a large extent the pyrethrum flowers formerly imported from Asia and Central Europe.

Propiolic Acid Resins

Wide Series of Condensation Products

NEW methods of manufacture of propiolic acid from acetylene (*see* THE CHEMICAL AGE, 1941, *44*, 1128, 87) have stimulated interest in the potential industrial uses of this highly reactive acid. It is now pointed out (B.P. 532,535; Du Pont) that under certain conditions the acid condenses with hydroxy compounds of the most varied types to form products of interest for the varnish and plastics industries. Particularly interesting products result from condensation with polyhydric alcohols like ethylene glycol, glycerol, and pentaerythritol, while attention is also merited by the products of condensation with sugars and polyvinyl alcohol. In the reaction with ethylene glycol a water-soluble intermediate is formed in the shape of a highly viscous oil, but this can be rendered insoluble and tough by continued heating. On the other hand, in the case of pentaerythritol, the intermediate form (which is soft and rubbery in the wet state, but tough and leathery when dry) is insoluble in water as well as in most organic solvents. When baked at 150° C. the pentaerythritol-propiolic acid resin becomes hard and tough. Essential conditions for the formation of resinous masses include heating of the mixed components for several days at a temperature of about 110° C.

The condensation of cane sugar under these conditions with propiolic acid results in formation of a black stiff tar, but a resin resembling hard lac can be isolated by extraction with formamide and treatment of the formamide solution with water. The resin does not fuse when heated as high as 240° C. Prolonged heat treatment of a mixture of propiolic acid, glycerol and linseed oil results in formation, among other products, of a modified drying oil which surpasses linseed oil itself both in baking and drying qualities.

Recovery of Silver

Guanidine Derivates as Precipitating Agents

ELECTROLYSIS of spent fixing solutions has been the method generally adopted in recovering silver from the silver thiosulphate complex, but this is economical only on a relatively large scale. Reagents which are now found to be useful precipitating agents for the silver are guanidine derivatives, such as guanidine ethyl xanthate and guanidine anthranilate, and the spent bath is, moreover, regenerated to the extent that it can again be used in admixture with fresh fixing solution. A typical spent fixing solution was stirred a short time with guanidine anthranilate in the proportion of one gram per litre of solution; the *p*H was adjusted to 10 (with caustic alkali). After standing for 24 hours the dark precipitate was filtered off, mixed with a flux and the silver isolated by heating to 815-1035° C. Other liquors from which silver may be recovered with the aid of the new reagents are the wash waters from emulsion manufacture, paper manufacture, and scrap film burners. (U.S.P. 2,221,163.)

Colour Test for Clays

Benzidine as Indicator of Montmorillonite

ONE of the important types of clay used for many purposes including oil-well drilling is that known as bentonite. The term "bentonite" has been so much misused recently that an effort is being made to avoid loose terminology and refer to the minerals composing the bentonite. Of these, montmorillonite is the most common component. Identification of a clay to determine whether it is a montmorillonite is a difficult task. Measurement of the physical properties of a clay by a tedious series of tests has been the most usual way, and the determination has not been satisfactory. Even X-ray examination involving complex research methods has not solved the problem.

An extremely simple colour test to indicate the montmorillonite content of clays has been developed by Hendricks and Alexander (*J. Amer. Soc. Agronomy*, 1940, *32*, 455-8) and is reported in U.S. Bureau of Mines, R.I. 3556, by A. G. Stern. The reagent used is benzidine, which is slightly soluble in water (about 0.5 per cent.); hence a saturated solution is readily prepared by shaking the benzidine with water. A small white test plate, dropper, and penknife complete the equipment. A small sample of the dry pulverised clay to be tested is placed on the test plate and a few drops of the benzidine reagent are used to wet it, and, if a vivid blue colour results, montmorillonite probably is present. The test is sufficiently sensitive for the clay to be diluted with 500 parts of inert material, and still to give enough blue colour to be detected when benzidine is added.

Synthesis of Ethyl Benzene

High Yields from Ethylene and Benzene

ETHYL benzene is an intermediate of growing importance to the plastics industry because of the comparative ease with which it can be dehydrogenated to styrene. Resins on the basis of polymerised styrene have been relatively expensive, so that a new method for improving the yields of ethyl benzene possesses both economic and technical interest.

When ethylene is reacted with benzene in the presence of aluminium chloride the maximum yield of ethyl benzene is 50 per cent. (calculated on the ethylene), while a considerable amount of polyethyl benzenes is formed. The yield of the former can be increased, and that of the polyethyl benzenes decreased, by operating in presence of a smaller proportion of propylene as described in U.S.P. 2,225,543 (Dow Chemical Company). A mixed gas derived from cracked petroleum and from which higher olefines (butylenes, amylenes) have been removed is a suitable raw material. A mixture of 1310 gm. benzene and 50 gm. aluminium chloride was reacted with a gas containing 59.7 per cent. (by weight) ethylene and 41.3 per cent. propylene, the latter being added with agitation at the rate of 56.5 gm. per hour for 4.75 hours. Careful fractionation of the dried reaction product gave a 61.5 yield of ethyl benzene, while diethyl benzene was only formed to the extent of 7.7 per cent.

By-Product Waxes

New Fractional Fusion Process

DEVELOPMENT of a new process for the sweating (fractional fusion) of waxes is announced by the B. F. Sturtevant Co., Hyde Park, Boston, Mass., working in conjunction with engineers of the Socony-Vacuum Oil Co. Advantages of the process include improved quality, reduction in manufacturing time and costs, and increased sales value.

The waxes are a by-product of the manufacture of motor spirit, lubricating oils, etc., from crude petroleum. The crude wax mass is a mixture of several constituents, which when separated present several kinds of wax with different characteristics, uses, and market values. They are used in coatings for paper, in waterproofing compounds for cloth, in electric wire insulation, in lining material for food containers, and for many other purposes.

The process consists essentially of an apparatus arrangement and control system by means of which the hot melted crude wax mixture is run into pans in a closed room. The wax mass is cooled under close control, each individual constituent freezing separately as cooling proceeds, until the pans contain total solids. Then all non-waxlike oils drain off, leaving only the wax mixture in solid form. Heating then takes place under absolute control, the temperature rising slowly and pausing as each fraction fuses and the resulting liquid fraction is drawn off, until all waxes up to the highest melting point are gone from the pans.

The apparatus consists of an evaporative cooler, steam heating unit, circulating fan, distributing ducts in the room, and pipe coils with water pump in the pans. The air is circulated rapidly in the room, cooled or heated as the case may be, and the water is maintained approximately at the air temperatures.

General News

THE NEW ADDRESS of Bryce, Robarts and Co., Ltd., is : Cree House, Creechurch Lane, London, E.C.3 (Tel. : AVEnue 3377/8.)

THE MINISTRY OF FOOD announces that there will be no change in the existing prices of oils and fats allocated to primary wholesalers and large trade users for the five weeks ending May 3.

THE LONDON SHELLAC RESEARCH BUREAU, India House, W.C.2, has issued a booklet of abstracts bearing on shellac research literature for the year 1940. It contains also an author-index and a subject-index.

AMONG THE NEW MEMBERS elected last month to the Manchester Chamber of Commerce were F. Collins, Ltd., chemical merchants, and the General Kaputine Syndicate, Ltd., manufacturing chemists.

DONATIONS TO THE Clydeside Air Raid Distress Fund include £1000 from the Burmah Oil Co., Ltd.; £500 from Scottish Oils, Ltd.; and £100 from Montgomerie, Stobo, and Co., Ltd., manufacturers of paints, oils, soap, etc., Glasgow.

A NEW EDITION of the Bristol Engineering Directory has been issued. It is published by the Bristol Manufacturers' Association which was formed to publicise the manifold activities of Bristol Engineering. The directory can be obtained free (postage 4d.) from Mr. J. E. Evans, 104 Filton Avenue, Bristol, 7.

MEN ENGAGED IN FULL-TIME EMPLOYMENT in the brick, tile, cement, and pottery manufacture; in coke ovens and by-products works; in explosives and chemical manufacture; and in metal and metal goods manufacture are among those who are not required to register with their age-groups on April 5 for work of national importance.

TO MARK THE CENTENARY of the Royal Botanic Gardens, Kew, the first director of which, Sir William Hooker, took office on April 1, 1841, Sir Arthur Hill, the present director, read a paper to the Linnean Society on Thursday. A broadcast programme describing the Gardens' history in the last 100 years was delivered on Monday evening.

A LIST OF ORDERS issued between October, 1940, and March, 1941, by the Controller of Dyestuffs, is being circulated by the Dyestuffs Control Committee. Dye users are having their attention drawn to these Orders by a notice which is appearing on all invoices sent to them by their dyestuff suppliers, and full particulars of the terms of the Orders (Nos. 1 to 13) can be obtained on application to the Editor of THE CHEMICAL AGE.

THE TRADING WITH THE ENEMY (Specified Persons) (Amendment) (No. 4) Order, 1941, contains a number of additions and a few deletions from the previous list of persons and firms in neutral countries with whom trading is illegal. It includes the Instituto Behring de Therapeutica Experimental Ltda., Rio de Janeiro, the Cia. de Productos Chimicos e Industriaes M. Hamers, S.A., Rio de Janeiro, and Ching Kong Sen Dyers and Chemicals Co., Shanghai.

AT THE ROYAL INSTITUTION, Albemarle Street, W.1, on Friday afternoon, Professor E. N. de C. Andrade, D.Sc., Ph.D., F.R.S., Quain Professor of Physics in the University of London, delivered the 25th Guthrie Lecture, entitled "A Problem of Guthrie's Time." The occasion was a meeting of the Physical Society, and the subject of the lecture was sensitive flames, or rather sensitive jets in general, one of the types of acoustical investigation so elegantly and so successfully carried out by Professor Andrade and his pupils at University College, London.

Foreign News

PRODUCTION FROM THE NICKEL MINES at Salmijärvi, near Petsamo, N. Finland, is stated to be due to restart this spring. It was reported last autumn that the mines of the Canadian Mond Nickel Company there had been sold to the Soviet Government.

SITUATED IN THE ITALIAN ALPS, the S.A. Nazionale "Cogne," a government-sponsored concern, is reported to be building a new plant for the manufacture of metallic magnesium from the local dolomite. Mined at a height of 8000 ft., the ore is conveyed by rope-railway to the Aosta furnaces, where the new plant will be erected. These furnaces have already provided a target for the R.A.F.

From Week to Week

EFFORTS ARE BEING MADE to develop an aluminium and magnesium industry in Spain, but for the time being the project is confined to the construction of a plant at Valladolid, with an annual productive capacity of 5000 metric tons.

THE FORECAST FOR ALL INDIA of the 1940-41 sesamum (gingelly) crop indicates a decrease of 0.4 per cent. in the area planted, but an increase in yield of 1.8 per cent. over 1939-40—401,000 tons against 394,000.

THE MALAYAN INFORMATION AGENCY in London reports that the local output of tin and tin in ore at 75.5 per cent. in February was as follows : Federated States, 4899 tons; Unfederated States, 171 tons; and Straits Settlements, 11 tons.

IT IS LEARNED IN LONDON that scientists in Brazil have recently discovered that surplus coffee, which has hitherto been burned in large quantities, can be made into a plastic material called "cafelite," which can be used in the manufacture of aeroplane and motor car components, and that a factory for the production of this material is on the point of completion.

THE PRODUCTION OF ACETONE by direct synthesis, presumably from calcium carbide, is being undertaken, for the first time in Japan, by the Korean Nitrogen Fertiliser Co. Hitherto Japan was dependent on imports (mostly from U.S.A.) for this solvent, except for small quantities produced by maize fermentation. Imports in 1939 were 2,750,000 kg.

ACCORDING TO FIGURES COMPILED by the National Fertiliser Association of America, United States production of superphosphate in 1940 was 15 per cent. higher than in 1939, and only slightly below the peak figure of 1937. During 1940, the amount produced was 3,784,405 tons and shipments 4,096,643 tons, compared with 3,297,502 tons and 3,779,287 tons respectively in 1939.

NEWS COMES FROM AUSTRALIA that a truck driver has originated an anti-knock compound by mixing eucalyptus oil with his petrol. Other motorists have repeated this experiment, and report that their cars have increased power and mileage. The Sydney Technological Museum began to investigate the matter in August, and Mr. A. R. De Penfold, curator of the museum, disclosed that a by-product of certain industrial eucalyptus oils, phellandrene, is effective as an anti-knock compound. To prevent the exploitation of the process a provisional patent was taken out in September after the initial experiments had proved successful. The final result may be of interest to the Defence Department.

Forthcoming Events

THE NEXT MEETING of the London Section of the Society of Chemical Industry will be held at Burlington House, in the rooms of the Chemical Society, at 2 p.m., on April 7, when Mr. N. E. F. Hitchcock, of Messrs. C. C. Wakefield & Co., Ltd., will read a paper on "The Production, Testing, and Application of Lubricants." The meeting will be of special interest to chemical engineers who are invited to attend.

"COLLOID CHEMISTRY OF PRESERVED LATEX" is the subject of addresses to be given at a meeting of the London Section of the Institution of the Rubber Industry at the Charing Cross Hotel, London, on April 7, at 5.30 p.m. Mr. H. C. Baker, M.Sc., A.I.C., F.I.R.I., will speak on "Distribution of Non-Rubber Substances," and Mr. W. G. Wren, A.R.C.S., B.Sc., D.I.C., on "Applications of the Langmuir Trough."

THE ANNUAL MEETING of the Notts and Derby Section of the British Association of Chemists will be held on April 8 at 7 p.m. at the Park Hotel, Chaddesden, Derby.

IN PLACE OF THE ANNUAL DINNER DANCE, the Midland Committee of the Society of Chemical Industry has arranged a formal luncheon at the Midland Hotel, Birmingham, at 1.30 p.m., on April 26. Ladies may be invited. After short speeches there will be dancing, followed by a display of cinematograph films until 5 p.m. Tickets, application not later than April 21, can be had from George King, for 7s. 6d. each, at 39 Upland Road, Selly Park, Birmingham, 29.

Personal Notes

DR. F. C. HALL, M.Inst.Chem.E., has joined the staff of I.C.I. (Explosives), Ltd.

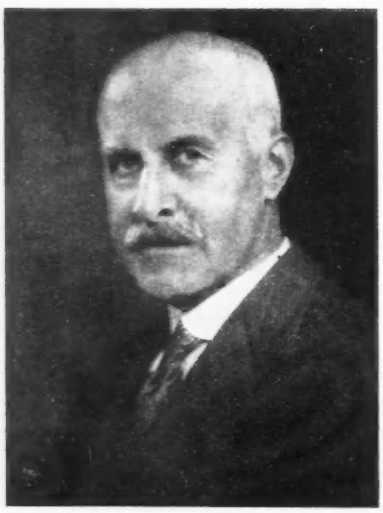
MR. JOHN SUTHERLAND, M.Inst.Chem.E., has been appointed a managing director of B. Laporte, Ltd.

SIR W. BENTON JONES has joined the board of Stewarts and Lloyds, Ltd.

MR. W. H. COATES, a director of Imperial Chemical Industries, Ltd., has been released by his company to act as financial adviser at Ottawa to Mr. Malcolm MacDonald, High Commissioner in Canada.

MR. WALTER GARNER, head chemist of Messrs. Lister & Co., Ltd., was last week elected chairman of the Yorkshire Section of the Textile Institute, and PROFESSOR J. B. SPEAKMAN, of Leeds University, was elected vice-chairman.

MR. T. H. GANT has been elected chairman of the Birmingham and Midlands section of the Institute of Chemistry. Other officers are: vice-chairman, DR. S. R. CARTER; honorary treasurer, DR. W. J. HICKINBOTHAM; honorary secretary, MR. E. M. JOINER.



Professor J. C. Philip, O.B.E., F.R.S.

The election of PROFESSOR JAMES CHARLES PHILIP, O.B.E., F.R.S., as President of the Chemical Society, was announced at the 100th annual general meeting of the Society at Burlington House on April 3. SIR ROBERT ROBINSON, F.R.S., the retiring president, delivered an address on "The Mechanism of Benzidine Rearrangement and Some Related Topics."

The following were appointed at the annual general meeting of the Association of Tar Distillers on March 18, to serve as officers for the ensuing year:—President, COL. W. A. BRISTOW; Vice-President and Hon. Treasurer, MR. C. E. CAREY; Hon. Auditor, MR. E. HARDMAN. The acting secretary is MR. R. MURDIN DRAKE, O.B.E., M.Sc.

SIR CECIL WEIR, K.B.E., M.C., has been appointed by the President of the Board of Trade to be Controller-General of Factory and Storage Premises. Sir Cecil, who is a member of the Industrial and Export Council, will take up his duties shortly and a further announcement will then be made with regard to the central and regional organisation of the Control and the date from which it will operate.

OBITUARY

MR. WILLIAM HOLT, whose death on April 1 at Widnes at the age of 74 has been announced, was works manager to the I.C.I.

MR. WILLIAM THOMAS RIGBY, who died on March 26 at Wylde Green, Birmingham, aged 78, was for 48 years Public Analyst for Warwickshire and for 20 years, until his recent retirement, held the same post for Birmingham.

MR. DOUGLAS LEACH, whose death took place in hospital at Widnes on March 16, was senior works foreman, since 1940, at the High Speed Steel Alloys, Ltd., where he began as a process worker in 1915. Mr. Leach was 53.

PROFESSOR HERBERT FINLAY FREUNDLICH, who died at Minneapolis, U.S.A., on March 29, aged 61, was one of the world's most distinguished colloid chemists. He resigned his post at the Kaiser Wilhelm Institute for Physical Chemistry at Dahlem, Germany, in 1933 and came to London. Afterwards he went to the University of Minnesota, where he studied until his death.

New Control Orders

Price of Greases and Tallows

THE Minister of Food has made an Order amending the Animal Oils and Fats (Provisional Control) (No. 2) Order, 1939, which comes into force on April 7, and fixes the following maximum prices for home melt skin greases:—Special white skin grease under 5 per cent. F.F.A., £23 10s. per ton naked ex factory. Ordinary white skin grease 5 per cent. or over F.F.A., £22 10s. per ton naked ex factory. Brown skin grease, £18 10s. per ton naked ex factory.

Sellers of home melt bone greases, technical tallows, or skin greases are required to furnish every buyer with an invoice showing separately the price, naked ex factory, of the home melt bone grease, technical tallow, or skin grease, as the case may be, the cost of the packages, where these are provided by the seller, and the actual amount paid for transport charges where these charges are paid by the seller.

Benzaldehyde, Phthalic Anhydride, etc.

Under the terms of an Order (S.R. & O. 1941, No. 425) issued by the Board of Trade, licences will in future be required to export benzaldehyde, benzoic acid and its salts and esters, phthalic acid and its salts and esters, and phthalic anhydride to any destination.

Export of Lecithin

The Board of Trade has made the Export of Goods (Control) (No. 11) Order, 1941 (S.R. & O., 1941, No. 355), which came into force on April 3. Among the provisions of this Order, which affects the export of practically all foodstuffs to all destinations, is a direction to the effect that licences will be required to export gelatine and lecithin (including mixtures of lecithin and oil or fat) to all destinations.

British Chemical Prices

Market Reports

THE position of the industrial chemicals shows little change from that reported last week. In all sections dealers report a steady enquiry for new business covering fair and average quantities, whilst deliveries to consumers under contract commitments are understood to be satisfactory. There has been no alteration in quoted rates and the undertone throughout is decidedly firm. A slightly improved demand is reported from the coal tar product section. Creosote oil is strong on an active demand and a wider enquiry is in circulation for cresylic acid. A fair business is passing in crude carbolic, although there is still room for improvement in the demand for pitch. There are no actual changes in quotation to record in this market.

MANCHESTER.—Firmness has continued in evidence in most sections of the Manchester chemical market during the past week, and orders already held are being steadily drawn against, although it is reported that both home and export enquiries regarding additional commitments have been no more than moderate in most departments. Most descriptions of by-products at the moment are very strong, and it is reported this week that in one or two sections, cresylic acid, for example, makers are well sold forward. There have been rises in price for cresylic acid and the xylols.

GLASGOW.—Business in the heavy Scottish chemical trade is still rather quiet both for home and export. Prices keep very firm with a tendency to rise.

Price Changes

Cresylic Acid.—MANCHESTER: Pale, 99/100%, 2s. 6d. per gal.

Iodine.—Resublimed B.P., 9s. 11d. to 13s. 11d. per lb., according to quantity.

Xylol.—MANCHESTER: 3s. 3½. to 3s. 8d. per gal.

Metallurgical Section

Published the first Saturday in the month

Inventions in the Chemical Industry

The following information is prepared from the Official Patents Journal. Printed copies of Specifications accepted may be obtained from the Patent Office, 25 Southampton Buildings, London, W.C.2, at 1s. each. The numbers given under "Applications for Patents" are for reference in all correspondence up to the acceptance of the Complete Specification.

Applications for Patents

CONDENSATION PRODUCTS.—American Cyanamid Co. (United States, Dec. 30, '39.) 2510.

PRODUCTION OF ANHYDROUS MAGNESIUM SULPHATE.—American Zinc Lead and Smelting Co. (United States, Feb. 23, '40.) 2507.

PRODUCTION OF AVIATION, ETC., FUELS.—Anglo-Iranian Oil Co., Ltd., and D. A. Howes. 2522.

PRODUCTION OF IRON AND STEEL ALLOYS.—V. Arata. (Italy, Feb. 27, '40.) 2325.

PROCESS FOR THE FRACTIONATION OF GAS, ETC.—R. M. Barrer. 2494.

PREPARATION OF DIHYDROPYRAN.—J. G. M. Brenner, D. McNeil, and Imperial Chemical Industries, Ltd. 2390.

MANUFACTURE OF OLEFINE OXIDES.—British Oxygen Co., Ltd., and P. M. Schuftan. 2361.

ELECTROCHEMICAL TREATMENT OF METALS.—British Thomson-Houston Co., Ltd. (United States, Feb. 29, '40.) 2551.

MANUFACTURE OF BARBITURIC ACID DERIVATIVES.—H. C. Carrington and Imperial Chemical Industries, Ltd. 2476.

MANUFACTURE OF SULPHUR TRIOXIDE—J. Cathala. 2516.

PREPARATION OF TOCOPHEROL.—Distillation Products, Inc. (United States, March 2, '40.) 2310. (United States, Aug. 24, '40.) 2311.

MANUFACTURE OF ORGANIC COMPOUNDS.—H. Dreyfus. (May 9, '39.) 2471.

MANUFACTURE OF ORGANIC COLOURING MATERIALS.—E. I. du Pont de Nemours and Co. (United States, Feb. 23, '40.) 2473.

POLYMERISATION OF FORMALDEHYDE.—E. I. du Pont de Nemours and Co., and C. E. Frank. 2475.

MANUFACTURE OF DYESTUFFS and intermediates therefor.—E. I. du Pont de Nemours and Co. and J. E. Kirby. 2598.

MANUFACTURE OF MOISTURE-PROOF MATERIALS.—E. I. du Pont de Nemours and Co., and J. A. Mitchell. 2392.

MANUFACTURE OF ORGANIC SULPHUR COMPOUNDS.—E. I. du Pont de Nemours and Co., and B. M. Sturgis. 2596.

PRODUCTION OF GLYCOLIDE RESINS.—E. I. du Pont de Nemours and Co. and W. O. Teeters. 2597.

MANUFACTURE OF AZO DYESTUFFS.—E. I. du Pont de Nemours and Co., S. S. Rossander, W. P. Reynolds, and C. E. Sparks. 2472.

MANUFACTURE OF DYESTUFFS of the anthraquinone series.—E. I. du Pont de Nemours and Co., A. J. Wuertz, and E. C. Tobin. 2474.

MANUFACTURE OF GRANULAR FERTILISERS.—H. W. K. Jennings (Directie van de Staatsmijnen in Limburg). 2623.

Complete Specifications Accepted

FLUORESCENT MATERIALS.—British Thomson-Houston Co., Ltd. June 17, 1938. 530,021.

ELASTIC-FLUID TURBINES.—British Thomson-Houston Co., Ltd. June 17, 1938. 530,022.

PRODUCTION AND USE OF SOLUTIONS of high molecular-weight sulphur-containing condensation products.—Rutgerswerke, A.-G. July 14, 1938. 530,026.

METHOD OF RECOVERING LITHIUM FROM MINERALS.—Bolidens Gruv A/B. June 22, 1938. (Corresponding Applications, 17429/39, 17430/39, and 17431/39.) 530,028.

REGENERATION OF SPENT CATALYSTS in the synthesis of hydrocarbons from carbon monoxide and hydrogen.—H. E. Potts (N. V. Internationale Koolwaterstoffen Synthese Maatschappij (International Hydrocarbon Synthesis Co.)). June 15, 1939. 530,036.

PRECIPITATION OF CELLULOSE TRIACETATE.—Kodak, Ltd. June 16, 1938. 530,037.

GAS BURNERS having catalytic ignition devices.—W. W. Groves (Junkers and Co., Ges.). June 17, 1939. 530,136.

PRODUCTION OF HYDROXYLAMINE SALTS.—I. G. Farbenindustrie. July 29, 1938. 530,173.

PREPARATION OF THERAPEUTICALLY USEFUL HETEROCYCLIC COMPOUNDS.—May and Baker, Ltd., A. J. Ewins, and M. A. Phillips. June 20, 1939. (Addition to 512,145.) 530,187.

DIE-PRESSES FOR WORKING METAL.—Schoemann, A.-G. July 9, 1938. 530,188.

MANUFACTURE OF LIQUID HYDROCARBONS from gaseous and solid carbonaceous materials.—E. A. Ocon. June 21, 1939. 530,291.

Metallurgical Section

April 5, 1941

PROTECTIVE ATMOSPHERES FOR HARDENING STEEL*

Development of "Endogas"

by J. R. GIER

Westinghouse Electric and Manufacturing Co., Pittsburgh, Pennsylvania.

WHEN steels are heated for hardening, they become chemically active towards the furnace atmosphere and suffer considerable surface damage unless protected in some way. This damage may consist of scaling by oxidation, decarburisation of the underlying metal, or both.

Oxidation can be prevented simply by maintaining a reducing atmosphere in the heating chamber. To prevent both changes in carbon content and oxidation, it is necessary to meet certain vital additional requirements of gas composition. Failure to meet these has caused serious trouble from decarburisation when attempts have been made to use ordinary bright-annealing atmospheres for hardening steels; although these gases prevent scale, they do not prevent decarburisation. In fact, they seem to increase the depth of decarburisation, since none of the affected metal is removed by scaling.

The problem of preventing scaling and decarburisation during heat treatment has been studied by numerous investigators, and current industrial practice makes use of several different atmospheres with this end in view. Although they are useful in a limited way, none of these schemes offers a broad general solution of the problem. These atmospheres and their characteristics are briefly as follows.

Characteristic Atmospheres

The most common procedure involves feeding raw mixtures of air and hydrocarbon gas into the heating chamber of an electric furnace or closed-muffle gas-fired furnace. The gas and air react in the furnace, but complete equilibrium is seldom approached except in high-speed steel-hardening furnaces operating at 1200° to 1290° C. In moderate-temperature furnaces the incomplete reaction of the gas components makes it practically impossible to adjust the mixture to balance the carbon in the steel. In the low-temperature range this scheme has proved useful in minimising or preventing scaling where some change in surface carbon can be tolerated. However, as now used, this type of atmosphere tends either to carburise or decarburise to some extent, its chief advantage being its simplicity and low cost. Charcoal gas from a generator built into and heated by a high-temperature gas-fired muffle furnace for high-speed steel is now being used. The composition, and therefore the carbon pressure, of this gas is determined by the furnace temperature. This gas is not adaptable to independent control, but is being used with certain types of high-speed steel for which its carbon pressure happens to be correct.

A modified atmosphere composed chiefly of charcoal gas has been developed for use in moderate-temperature furnaces for hardening. This atmosphere is produced in a separate charcoal gas producer; then hydrocarbons and sometimes raw ammonia are added to it. The hydrocarbon is added to offset the decarburising tendency of the straight producer gas, but no valid explanation of the reason for adding the ammonia is known to the author. This atmosphere is highly reducing and slightly carburising. It has given good results in bright hardening high-carbon steel or certain lower carbon steel parts that can tolerate some increase in surface carbon.

Another type of atmosphere used for hardening high-carbon steels, particularly tool steels, is one formed by cracking hydrocarbon liquids to give an atmosphere high in hydrogen and carbon monoxide and containing a few per cent. of methane. As this mixture is substantially free of carbon dioxide and water, it tends to be carburising. It is expensive and is used exclusively in furnaces with gas-tight metal heating chambers.

Dissociated Ammonia

A recent paper described the use of an atmosphere of dissociated ammonia for hardening tool steels. This gas is strongly reducing, even to stainless steels, and is relatively inactive toward the carbon in steel when very dry (dew point below −40° C.). For the necessary purity to be maintained while in contact with the work, it must be used in a metal muffle furnace of special design; this fact, together with its relatively high cost, restricts its application to special work.

While the above-mentioned atmospheres are useful in a limited way, a need exists for an atmosphere which is applicable to the bright hardening of steels of any carbon content in any temperature range, and which at the same time can be produced simply and inexpensively. An atmosphere that has recently been developed appears to meet the case. It is produced by the endothermic reaction of air and hydrocarbon fuel mixtures in a special generator containing an electrically heated catalyst. For this reason it is referred to as endogas-controlled atmosphere. This gas differs from similarly prepared mixtures in one fundamental respect; the completeness of the reactions obtained produces a mixture whose components are in chemical equilibrium and are present in accurately controlled amounts. This enables the carbon pressure of the gas mixture to be readily adjusted to balance the carbon in any steel. The gas is formed in a single step and is delivered directly to the furnace from the generator; no intermediate processing such as drying or carbon dioxide scrubbing is necessary.

Essentials of a Protective Gas

A really protective gas for steel must meet two important conditions. First, it must be reducing; that is, it must not contain free oxygen at a partial pressure greater than the dissociation pressure of the oxide of the metal. This condition can be met by having a sufficient proportion of the reducing gases, hydrogen and carbon monoxide, relative to the oxidising components, carbon dioxide and water. (High-chromium alloys will oxidise on slow cooling in atmospheres containing more than a trace of carbon monoxide.) Secondly, it must have a carbon pressure equal to that of the steel. The phrase "carbon pressure" is used here to indicate the

* From an article presented before the Division of Gas and Fuel Chemistry at the 100th meeting of the American Chemical Society, Detroit, Mich., and published in *Ind. Eng. Chem.*, 1941, *33*, 1, pp. 38-41.

carbon-forming potential of the gas, and under equilibrium conditions is equal to the fugacity of the carbon in the steel.

In a gas mixture where active components such as methane, hydrogen, and water are present, they can react with the carbon monoxide and dioxide and thereby determine the carbon pressure of the mixture. The striking fact is that the carbon dioxide content is less than can be measured by ordinary means for medium or higher carbon steel; and yet it is the carbon dioxide content that in effect controls carbon pressure. Consideration of the small but critical amounts of carbon dioxide and water required for balance with the carbon in steel, together with the fact that these can react and change in amount, explains why it is unpractical to try to obtain the desired mixture by mixing gas components.

Equilibrium Formation

A better solution of this problem has been found by mixing air and a hydrocarbon fuel in controlled proportions, then passing this mixture through an electrically heated catalyst where it is completely reacted to form an equilibrium mixture of the desired composition. The product so obtained is referred to here as "endogas" because of the endothermic character of the forming process. In this reaction the hydrocarbons are almost completely decomposed into carbon and hydrogen. The carbon is combined with oxygen to form carbon monoxide: this reaction is exothermic, but insufficient heat is generated by it to balance the above endothermic reaction and supply the losses. The energy deficiency is supplied by an external electric heater. Water vapour and carbon dioxide are present only in the small amounts essential to chemical equilibrium of the gas components.

To determine the relation between the feed ratio of the generator and the carbon pressure of the product gas, a series of specimens were heated to 925° C. in various mixtures. As expected, the equilibrium carbon content of the specimens, and accordingly the carbon pressure of the gas, was found to be a sensitive function of feed ratio. By this means it is possible to produce atmospheres of any desired carbon pressure within the range required for the heat treatment of steels without change in surface carbon.

Evidence of a true carbon equilibrium between the steel and the gas was obtained in an experiment in which specimens of steel having widely different carbon content were heated together in the same gas. Two strips of steel 0.006 in. thick, one containing 1.2 per cent. carbon and the other containing no carbon, were heated together in "endogas" for two hours at 925° C. and then rapidly cooled in the gas. The 1.2 per cent. carbon strip had decarburised down to 0.64 per cent. and the zero carbon strip had carburised up to 0.64 per cent. carbon; thus the point of equilibrium was the same for both directions of approach.

Factors Affecting "Endogas"

When "endogas" is used in industrial furnaces, there are two factors that can cause the gas to change in composition after it leaves the generator. One is that the furnace may be at a lower temperature than the generator, thus tending to cause a slight readjustment in the gas to a new temperature equilibrium. The other is the effect of contamination by the diffusion of oxidising gases from the brickwork of the furnace or from the outside. These factors tend to increase the water and carbon dioxide and thereby lower the carbon pressure of the furnace atmosphere relative to the fresh inlet gas. However, this is not a serious matter, since the difference can be offset by making the carbon pressure of the inlet gas correspondingly higher so that it will be correct while it is in the furnace.

Experience has shown that for short-cycle heating, as for hardening some steels, an approximate adjustment of the carbon pressure is satisfactory. Where the discrepancy in pressure between the steel and the gas amounts to not more than the equivalent of 0.2 or 0.3 per cent. carbon, the rate of carbon transfer to or from the steel is quite slow, particularly at the lower hardening temperatures of 790° to 840° C.

Since carbon pressure is the primary factor in the behaviour of this gas, some means of measuring this quality is essential if effective atmosphere control is to be obtained. Since it is a complex quantity that is determined by a carbon dioxide content below the range of measurement by ordinary chemical analysis, it became necessary to develop a device that would be directly responsive to carbon pressure and give a quantitative measure of its value. A device has been made for this purpose by the author and is known as a hot-wire gauge.

An alternative method of estimating the comparative carbon pressures of a balanced gas mixture is by measuring their water vapour content by dew-point determination. Dew-point measurements were made by passing a small flow of gas over a hollow polished metal bulb cooled with carbon dioxide snow dissolved in acetone contained in the bulb. A thermometer inserted in the bulb indicated the dew point—namely, the temperature at which moisture first condensed on the polished surface during slow cooling. While it might appear that the dew point could be used as a measure of carbon pressure, moisture content is not a measure of carbon pressure, although definitely related to it. In an equilibrium mixture of a given hydrogen content, water will vary inversely with the ratio of carbon monoxide to dioxide and the carbon pressure. Accordingly, an indicating device directly responsive to the carbon pressure of a gas is preferable for the accurate control of protective atmospheres for steel.

Although "endogas" was developed primarily for protecting steels in hardening furnaces, it is also suited for use as a diluent or carrier gas for gas carburising operations. When used for this purpose, enriching hydrocarbons are added after the gas leaves the generator.

MODERN REFRACTORIES

For many years the highly refractory qualities of magnesite, chrome, and more recently of chrome-magnesite, have been known, and such refractories are now widely used in several industries. It is only, however, within recent years that definite improvements have been made in manufacture, giving refractories which are capable of withstanding the severest operating conditions. By co-operating with two of the pioneers in this field, MESSRS. JOHN G. STEIN AND CO., Bonnybridge, Scotland, have been able to instal the best type of plant for producing basic refractories of the highest quality. With their own research and development facilities they are able to keep approaching nearer and nearer to the stringent requirements of modern furnace practice. In no branch of refractories have such important advances been made as in chrome and basic refractories, and their applications are becoming ever more varied. Briefly, the main advantages arising from their adoption are higher heats, faster driving, greater outputs and longer campaigns. An extremely well-produced booklet, copiously illustrated with photographs and diagrams, gives full details of the six brands supplied, viz.: Stein Magnesite, Stein Magnesite C, Stein Dimag, Stein KM, Stein Dikro, Stein Chrome. Each brand of refractory has its own particular properties and the range covers all needs of industries requiring basic or chrome refractories.

TIN EXPORTS

Licences for tin exports to the United States during April have been granted to approximately the same extent as in previous months. Licences for exports to other destinations, notably those in the Empire, will also continue to be granted to about the same extent as hitherto.

The news that there is to be no further restriction of the volume of tin exports has helped to stimulate demand for the commodity, and prices have advanced appreciably. At the same time, turnover has expanded to an unusually high figure.

Economies in White Bearing Metals

The Importance of Chemical Analysis

by C. C. DOWNIE

WHILE the attention of most engineers is devoted to the performance, maintenance, and general behaviour of white bearing metals, comparatively little is heard of the economies which can be gained in the initial preparation of these metals. It is usually contended that ingots of the pure constituent metals only can be utilised, but, except where the specification demands it, a wide variety of scrap alloys can be included, which very materially reduces the costs of manufacture.

Those acquainted with handling the latter type of bearing metal make a point of testing it by melting it, and raising it to different degrees of temperature to note if any appreciable dross forms on the surface. The product is then cast into a fine form of mould to ascertain how it takes the impression; when this is exceedingly sharp, it usually indicates the presence of arsenic. Such tests are really unnecessary when the alloy is made up from the virgin metals, but are advisable where scrap is included. If time permits, a short microscopical examination will reveal arsenic in the form of thin yellow lines around the crystals, while iron appears as small crosses throughout the mass.

Zinc is one of the most undesirable elements found in second-grade bearing alloys, as it tends to link up the hard and soft constituents, and although this is apparent in the crystalline structure when zinc is present in quantity, it is scarcely discernible to the extent of a few points per cent. There is always the risk, where turnings and borings have been melted down, that both zinc and aluminium may have been unwittingly included, as they display almost the same white appearance, and this applies particularly where the raw material has been gathered from machine-shop sweepings and the like.

One of the best methods of dealing with such impurities is to melt the scrap in a pot, which is lined with fine solder scum or oxides of tin and lead. After the heating has proceeded for a few minutes, the oxides break loose from the walls of the pot and rise through the molten mass, whereby both zinc and aluminium are oxidised. As a supplementary treatment, a few crystals of cryolite may also be included to dissolve out the aluminium. Large bearing-metal manufacturers employ a melting kettle in which steam is forced through a mass to affect the same oxidation, but this practice cannot easily be followed on the small scale, and hence the reason for using the former agents.

Scrap Materials Used

When it is a matter of utilising turnings and borings which have accumulated in outside shops, both brass and iron are almost invariably found to be present, together with general dirt and grease. Iron is removed by passing the mass through a magneting machine, while brass is skimmed off from the molten material with finely perforated ladles.

Reference should be made to the system of removing aluminium and even zinc with the assistance of high-gravity liquids, which cause the former to float on the surface, and be directly removed before melting, a method which holds the great advantage of obviating all risk of contamination. In actual practice, however, there are always turnings which are connected with one another, and hence, although the method is to be recommended, it is neither complete nor absolute, and has to be supplemented by the use of the agents already mentioned.

Bearings purchased from dismantled machinery provide the best class of metal, as this material has only to be melted in a kettle and some slight addition of one of the constituents made, when it is ready for use. Repeated melting of the same metal, where some error in composition has arisen, leads to an almost certain variation, since although antimony is not supposed to alloy with iron, it leaves a slight coating on the surface of the vessel. This can be ascertained by making a chemical test of the lining, and information on this subject was originally culled from printers who had met with the same experience. Where the antimony content is about 7 per cent., it is not of the same account, but it becomes more serious with hard bearing metals.

All meltings should be accompanied by full chemical analysis, which can be carried out by the latest methods in little more than half an hour. The reason why arsenic is present at all is because some low grade of lead will have been included, and it is apt to be overlooked because it gives finer castings, with increased fluidity and freedom from blowholes, but diminishes the toughness and hardness. Where the specification demands an unusually high percentage of copper, the resulting alloy is more difficult to melt and cast, and more readily forms dross. Should such metal get the opportunity to cool before casting, there is always the risk of a skin of copper-antimony forming on the surface, thus detracting from the remainder of the composition. The tendency is for copper and antimony to form a separate alloy from the remaining tin-lead-antimony, and under extreme conditions, *i.e.*, lengthy exposure in heated conditions, several per cent. of the former can be directly removed.

When an alloy of high copper and antimony content is being dealt with, the product should be melted with constant stirring, and cast as expeditiously as possible. This condition is quite unnecessary with all the softer bearing metals, and so long as the surface is covered by a protecting layer of grease or waste oil, little harm can come to them. For a dry bearing, where the coefficient of sliding friction is as low as possible, the hard, high antimony and copper alloys are still preferred, because they ensure greater durability. As the modern tendency with almost all types of plant is towards greater speed, the possibility of bearings heating up is greater, hence larger bearings of more tinny metal have become most popular. This has added to the difficulties of the smaller bearing-metal manufacturer, as tin cannot usually be obtained in scrap condition, and less scope is left for making economies.

Selecting the Best Compositions

Among the best scrap materials to acquire are pewter, siphon tops, decorative tin alloys (which are rich in tin), electric fuse metal, and strip tin. Tin-lead compositions where the lead is in greater proportion to the tin are almost unlimited, but in actual practice usage of such material generally leads to trouble sooner or later, so that some virgin tin has to be added. The greatest economy can be gained where some source of cheap tin is available, since scrap lead-antimony alloys are easily obtained. Pewter is supposed to contain 80 per cent. tin and 20 per cent. lead, but some samples on analysis contained only 45 per cent. tin, 52 per cent. lead, 3 per cent. antimony, and nearly 1 per cent. copper. Siphon tops contain 73 per cent. tin, 20 per cent. lead, 6 per cent. antimony, and 1 per cent. copper. Electric fuse metal contains upwards of 90 per cent. tin, 2-3 per cent. copper and antimony, and the rest lead. Scrap music type is another small source, and contains 87 per cent. tin, 12 per cent. lead, and 1 per cent. antimony and copper. Genuine tinman's solder contains 50 per cent. tin and 50 per cent. lead, but this is below the standard required by the average bearing for high speeds, and the same remark applies to most of the other tinny metals.

It is thus very important to discriminate between the rich tin and the low tin classes of scrap which are available, since most of the bearings for greater speeds will require some 70 per cent. tin. It is an easy matter to acquire scrap lead-

antimony compositions, with or without tin, but the great art is to concentrate on the tin. The original Babbitt metal of 89 per cent. tin, 7.3 per cent. antimony, and 3.7 per cent. copper was followed by both Admiralty and German navy to within a few per cent., but scrap metals free from lead were almost impossible to obtain. This meant that the virgin metals had to be used except where some odd tin-antimony preparation could be picked up.

A survey of analyses of bearings most widely applied in general engineering practice showed that lead was quite freely used, and this gave an impetus to the use of secondary metals. Large makers of bearing alloys soak tinplate in lead baths under specific conditions, as a continuous process, so as to remove all tin, and then eject the remaining sheet iron. By oxidising and "drossing" this lead, all tin is removed as a scum from the surface, which is then reduced to a rich tin-lead alloy by the addition of a little fine coal. Engineering firms who prepare their own bearing alloys seldom attempt the methods of the smelter, but utilise as many odd compositions as possible to reduce the costs. In order to be prepared for demands of different percentage compositions, it is necessary to stock a fair accumulation of different types of scrap and turnings, etc., and the most important classes are those rich in tin. Plumbers' rich solder sweepings come in handy where they have been used for dealing with coppery material, as they cannot be used by the plumber himself, and are usually available in shipyards. Each lot of turnings, small scrap, and floor sweepings is kept in a separate bin, with the number and analysis recorded on a card. The following will give an example of making up a mixture for white metal bearings which appears to be popular in the North Country, viz.: 75 per cent. tin, 15 per cent. lead, 5 per cent. antimony, and 5 per cent. copper. A glance at the tables of bearing alloys will reveal that this makes a good base metal, where not used directly for actual linings. The components used were as follows:—

	Tin	*Lead*	*Antimony*	*Copper*
Babbitt Turnings	89	—	7·3	3·7
Pewter	80	20	—	—
Siphon Tops	73	20	6	1
Plastic Lining Scrap ...	83	—	9	8
Tinman's Solder	50	50	—	—
Loco. Bearings	81	—	9	10
High Speed Lining ...	74	—	15	11
Plumbers' Tinny Sweepings	70	25	—	5
	600	115	46·3	38·7
Resulting Alloy	75	14·4	5·8	4·9

Some Supplementary Features

A margin is usually allowed of 1 per cent. "either way" and, as the melting is carried out at low temperatures, comparatively little, if any, appreciable melting loss is sustained. As a general rule, a more involved form of making up the mixture, with different weights of each component, is essential, and where one type of rich material becomes scanty, it is necessary to figure out the make-up with great accuracy, otherwise certain stocks will fall unduly low. In each of the foregoing components, the expensive tin content is obtained at well below the customary market price, and it is here that the greatest economy can be secured.

It is best to have the melting carried out in a gas-fired kettle, as the temperature can thus be most easily controlled, and it is a good plan to have the mass covered with some grease or oil waste, as this reduces the extent of skin formed. Where the alloy has not to be directly used for linings, and is required simply in ingot form, the pouring should be done slowly, and the surface of each ingot skimmed just at the point of solidifying.

All such skimmings, together with the skin from the surface of the kettle, are collected and melted in a small plumbago crucible together with about 5 per cent. of fine coal dross, and the reduced metal so obtained is returned to the kettle. There are thus practically no losses sustained. Metallic residues cannot be used with impunity, as impurities such as arsenic and nickel are liable to be present, but type-metal drosses from printing works are generally of high purity and can be used for their lead and antimony contents.

The secret of success is accurate chemical analysis, as there is comparatively little skill required in the melting process, which is usually carried out by unskilled labour. Where a demand arises for an undefined white bearing alloy for some special purpose, it is worth taking into account the atomic weight of the product, as computed from the constituents. Those of low atomic weight have a higher specific heat and thermal conductivity and, amplified by a larger bearing surface, give the coolest bearings. In general, the higher the speed which the bearing has to accommodate, the larger should be the bearing and the more tinny the composition. This is sometimes difficult to follow without practical experience, as some firms prefer a comparatively large bearing, rather than expend too much on the extra tin content; hence it is better to co-operate with the engineer responsible for the construction, so that the desired coolness may always be attained. Unlike brass and higher-melting-point metals, white bearing alloys may be re-melted several times if necessary, without adding largely to the costs, and this is to be recommended for preparing a stock alloy where many different compositions are demanded. A distinct line of demarcation should be drawn, however, between the rich tin and the rich copper products, as it is an easy matter to add intermediate lead and antimony, but more complicated to deal with the less fusible copper.

Steel Developments

Economical Die Steel

EXPERIMENTS have recently been made to satisfy the demand for a steel for dies used in the production of cold-formed or stamped parts, which would be cheaper than those at present in use and the properties of which would be such that accurate work over short runs would be obtainable. These led to the development of a chromium-vanadium-molybdenum steel, the vanadium being added to provide a wide range of heat-treatment and to prevent excessive grain growth, and the molybdenum used to give high hardness and improved hardness after tempering.

A typical heat-treatment is pack-hardening and air-quenching from 980° C., followed by tempering at 205° C. for 3 hours. This should give a final hardness of 61 Rockwell C and the distortion after hardening is negligible. It is claimed that the new steel enables a 40 per cent. saving to be made on the cost of short run dies. In addition, the steel has given such excellent results in service that it is being applied to a wide range of other parts.

A New High-Speed Steel

A new all-purpose steel is being marketed in the United States of America. It is claimed to be suitable for any type of cut from the heaviest hogging to the finest finishing in any type of material. The improved properties necessary to give this performance have been obtained by increasing the vanadium content of standard 18-4-1 to 2.5 per cent., adding 0.6 to 0.8 per cent. molybdenum, and raising the carbon content to 1.0 per cent. The novelty is said to be in the high carbon content which gives a hardness of 65 to 68 Rockwell C after standard heat-treatment.

This high hardness enables the steel to produce the surface necessary in fine finishing operations. The hardness, however, is obtained without sacrificing toughness, the mechanical properties being still equal approximately to those of normal 18-4-1 high-speed steel. Thus good shock-resisting properties make it available for intermittent cuts, while good red hardness renders it suitable for heavy cuts.

The approximate composition is 18 per cent. tungsten, 4 per cent. chromium, 2.5 per cent. vanadium, 0.6-0.8 per cent. molybdenum, and 1 per cent. carbon.—*Alloy Metals Review*, 1941, *3*, 19.

Special 18/8 Stainless Steels

Some Notes on Welding

WHEN ordinary stainless steel is subjected to prolonged heating, as in welding, its corrosion resistance may be impaired by carbide formation, which is largely governed by the speed with which the metal is cooled between 925 and 980° C. Since thin metal cools much more rapidly following welding than does thick metal, the available time for possible carbide formation in thin metal is greatly reduced. Therefore in the light gauges of metal (16-gauge and thinner) impairment of corrosion resistance due to carbide formation is not usually important. However, in the heavier gauges, (11-gauge to 16-gauge), and for applications involving severe corrosion, it may be a serious factor.

For welded fabrication of equipment designed for use under severe corrosive conditions, manufacturers supply, at slight extra cost, a special grade of 18/8 chrome-nickel stainless steel. This grade usually contains higher percentages of nickel and manganese which give it greater hot ductility, thus rendering it less subject to cracking due to thermal stresses resulting from welding. It also contains a small amount of columbium or titanium which is added during manufacture, and it is known as columbium- or titanium-bearing 18/8 stainless steel. Under conditions of high temperature, as encountered in welding, columbium and titanium combine preferentially with carbon and the corrosion resistance of the metal is maintained. Both columbium- and titanium-bearing 18/8 stainless steel are to be preferred in the annealed rather than the cold-rolled state because of the greater ease with which the annealed metal can be cold-worked.

Heated 18/8 stainless steel sheet expands about 50 per cent. more than similarly heated mild steel sheet and, for this reason, particular attention must be given to expansion and contraction during welding. Adequate control is provided by the use of jigs and fixtures, chill plates (preferably copper), and sometimes by the careful preheating of large surfaces in special jigs.

Special stainless steel flux must be used in welding 18/8 sheet. Oxides formed during the welding of this metal will not dissolve in ordinary fluxes such as are used for cast iron, brass, copper, bronze and aluminium.

Before welding is started, the special flux is applied to the sheet so as to cover the entire surfaces previously cleaned for joining. This may be done either on both sides of the sheet, or, when the operator is experienced, on one side only. In the latter event, the bottom or back rather than the front or top of the weld is the surface which is always covered. To aid its application, the dry flux is first mixed with water in a glass, porcelain, or other non-metallic container. The mixture, of about the consistency of milk, can be readily painted over the joint by means of a small brush. On some occasions it may also be found convenient to coat the welding rod with the flux mixture. This is best accomplished by heating the rod slightly before brushing the liquid over it.

Magnesium in 1940

American and German Production

ACCORDING to the Bureau of Mines, United States Department of the Interior, the primary magnesium production in the United States for 1940 reached the record total of 12,500,000 lb. The year's output was 87 per cent. above the previous peak of 6,700,000 lb. in 1939. The Dow Chemical Co., the sole domestic producers, expect the 1941 output to be 30,000,000 lb. Domestic sales of magnesium in 1940, which equalled the production, showed an increase of 17 per cent. over the previous year. Not only did the aircraft industry, the principal consumer, increase its requirements, but other industries, notably the munitions industry, began to use magnesium more widely. To cope with these requirements for magnesium products, plant facilities were greatly expanded during the year.

World producers of magnesium in 1940, in apparent order of importance, were Germany, the United Kingdom, the United States, Japan, France, U.S.S.R., Italy, and Switzerland. According to reliable sources, production in Germany was between 18,000 and 21,000 tons in 1940. Germany employed carnallite, potash and liquor, and some magnesite and dolomite as raw material. The electrolytic magnesium chloride process was generally employed, but experiments were recently begun on the direct thermal reduction of magnesium oxide. German uses for magnesium, due to the local lack of certain metals, include telephone switch parts, optical instruments, microscopes, bus-bars, and aerial bombs. In the manufacture of engraving plates, copper-zinc alloys have been replaced by magnesium alloys.

Electrolytic Chromium

Thermal Expansion Tested

AN investigation of the linear thermal expansion of electrolytic chromium has recently been completed by P. Hidnert at the U.S. National Bureau of Standards. Fifteen tests were made on two samples (99.3 and 98.7 per cent. chromium) at various temperatures between − 105° and + 715° C. with a precision comparator method and with an interference method. During the first heating or heatings, when hydrogen presumably was being evolved, the samples contracted in an irregular manner. After a few heatings, however, the irregularities disappeared and smooth expansion curves were obtained.

After the first heating to 500° C. and cooling to room temperature, the 99.3 per cent. sample was 1.1 per cent. shorter than the initial length before heating. The density of this sample increased 2.4 per cent. and the volume decreased 2.3 per cent. after three cycles of heating to 500° C. and cooling to room temperature.

The linear thermal expansion of electrolytic chromium is a function of the temperature, hydrogen content or liberation, time and rate of heating, previous treatment, etc., during the first heating or when irregularities (contraction) occur. The following table gives average calculated coefficients of expansion :—

Temperature Range. °C.	Average Coefficient of Expansion per °C. $\times 10^{-6}$
−100 to 0	5.1
0 to 100	6.6
0 to 200	7.3
0 to 300	7.9
0 to 400	8.4
0 to 500	8.8
0 to 600	9.1
0 to 700	9.4

Carbon Dioxide Removal

Treatment of Annealing Atmosphere

FOR certain types of annealing work an atmosphere free from carbon dioxide is necessary. A mixture of gases containing water, carbon dioxide, and carbon monoxide, although perfectly dry when put into a furnace, will combine at elevated temperatures according to the reaction

$$H_2 + CO_2 \longrightarrow CO + H_2O,$$

raise the dew point to an equilibrium condition, and thus neutralise the effect of drying. In removing carbon dioxide from such gaseous mixtures, a continuously recirculating regenerative system is generally used, which employs amine solutions, a process licensed under U.S. patents held by The Girdler Corporation. This system consists of a gas-scrubbing tower where the solution absorbs carbon dioxide from the gas, a solution-reactivating tower with boiler where the solution is heated to drive off the carbon dioxide, and the necessary recirculating pumps, heat exchangers, and coolers. Carbon dioxide can be consistently removed to less than 0.1 per cent. Water-amine solutions (usually monoethanolamine) will absorb carbon dioxide and hydrogen sulphide, while glycol-amine solutions will remove moisture to a saturation of about 7°–10° C. in addition to the carbon dioxide and hydrogen sulphide.

Spanish Manganese Ore

An Industry Needing Revival

THE production of manganese ore in Spain has shown a considerable decline in the past 20 years. In 1918, 77,714 metric tons of manganese ore were produced; by 1928 output had declined to 13,704 tons, but it rose to 17,916 in 1931. Since then production has been on such a small scale that many properties have been abandoned, and in 1934 output totalled only 3796 tons. According to consular reports published in *Mineral Trade Notes* of the U.S. Bureau of Mines, current production would appear to be about 6500 tons per annum. During the periods of high production Spain exported substantial quantities of manganese ore, but it also imported quantities for its steel industry. However, imports did not rise in proportion to the decline of domestic production, indicating that domestic consumption also declined. Imports during 1930 and 1931 amounted to 10,500 tons annually, declined in 1932 and 1933, but rose to 17,124 tons in 1934.

Manganese ore is produced in the Provinces of Asturias, Huesca, and Huelva. The richest mines in the Asturian area, at Buterrera, have a manganese content of 50 to 56 per cent., but at present production scarcely reaches 10 tons a month. The other Asturian mines produce 150 tons a month with an average manganese content of 51 per cent. Virtually all the ore produced in Asturias is used by the glass industry. In the Province of Huesca, the ores contain about 46 per cent. manganese, with only a small amount of silica, and are used principally for ferro-manganese. At present production amounts to 150 to 200 tons a month. The chief mines are at Estopiñán. There is only one ferro-manganese plant in Spain —at Corcubión in the Province of Corunna. The mines in Huelva Province are relatively low-grade, with ores containing 34 per cent. manganese and 15 to 23 per cent. silica. This ore is used principally for silico-manganese. While these mines are able to produce 5000 tons a year, their actual output is much less. It is possible to increase production to 20,000 tons annually, which would supply domestic needs.

The present price of manganese ore fluctuates between 4 and 7 pesetas per unit of maganese. The annual consumption of Spain is estimated at 12,000 to 15,000 tons of ore averaging 45 per cent. manganese. The Government is keenly interested in stimulating the industry.

Aluminium in Hungary

Increasing Production and Exports

SINCE 1935 the production of alumina and aluminium in Hungary has reached such proportions that the country has rapidly approached self-sufficiency and has, in addition, been exporting large quantities of bauxite, principally to Germany. The bauxite reserves in Hungary are the largest in Europe and are estimated at 250,000,000 metric tons. The only alumina plant in operation in Hungary is at Magyaróvár, near the Austrian and Slovak frontiers. The aluminium plant on Csepel Island obtains its supply of alumina from the Magyaróvár plant. There and other details are furnished by American consular reports from Budapest to "Mineral Trade Notes" of the U.S. Dept. of the Interior.

The Hungarian Bauxite Mine, Ltd. (Magyar Bauxitbanya R.T.), has announced that in conjunction with the United Incandescent Lamp and Electric, Ltd., it will establish a new plant at Ajka, south-west of Budapest, with an annual production of 20,000 tons of alumina and 10,000 tons of aluminium. The company will procure the bauxite from its mines in the vicinity, while the steam and electric current will be furnished by a new power plant with an annual capacity of 250 million kWh, to be constructed at a cost of 20 million pengö by the United Incandescent Lamp and Electric, Ltd. This plant, scheduled to begin operations in 1942, will furnish current to the aluminium plant under a long-term contract. Directors of the bauxite company state that the increased production of alumina and aluminium will not restrict existing bauxite exports, which may even increase.

Gas in the Light-Metal Industries

Information for Technicians

DEVELOPMENTS in the light-metal industries have been rapid during recent years, and war requirements have intensified the demand for supplies. Existing works have extended their operations in consequence, and new concerns have entered the light-alloy field. The publication, therefore, by the British Commercial Gas Association of "Gas as a Fuel for the Light-Metal Industries" comes at an opportune moment. The booklet (No. 12, "Industrial Uses of Gas" Series) deals in a comprehensive manner with the use of town gas in the manufacture of light metals; details of typical furnace installations, analyses of working results, and excellent illustrations of gas-fired apparatus increase its usefulness. Copies of this booklet can be obtained post free on application to the publishers, Gas Industry House, 1, Grosvenor Place, London, S.W.1. It should prove a valuable source of information on the subject to industrialists and technicians concerned with the manufacture of light metals.

Indian Aluminium Manufacture

Government Protection Assured

THE duty-free importation of alumina into India, announced in our issue of October 5 (THE CHEMICAL AGE, 1940, *43*, 1110, p. 158) is to continue. The concession, by a resolution of the Government of India Department of Commerce), dated December 14, 1940, is to remain in force for four years or until adequate supplies of alumina made in India are available at a reasonable price, whichever may be earlier.

In view of the fact that the production of aluminium in India is an urgent war necessity, the Government has given a further assurance to all who wish to undertake its manufacture in India that, provided their affairs are conducted on sound business lines, they will be given such measure of protection against unfair competition from outside India after the war as may be necessary to enable them to continue their existence.

Phosphor Bronze

New British Standard

A REVISED edition of the B.S. Specification for hard drawn phosphor-bronze and phosphorus deoxidised bronze tubes for aircraft purposes has been issued by the British Standards Institution. The principal revisions are as follows: The addition of manufacturing tolerances for tubes having a wall thickness of $\frac{3}{8}$ in. and up to 1 in. The size of the parcels for the selection of test samples is graded according to the weight per foot run of the tubes. Tubes having a wall thickness over $\frac{3}{8}$ in. are required to have an ultimate tensile stress of 23 tons per sq. in. Copies of the specification (No. 2T.52) can be obtained from the British Standards Institution, 28 Victoria Street, London, S.W.1, price 1s. 3d., post free.

U.S. MANGANESE IN 1940

United States shipments from domestic mines of manganese ore containing 35 per cent. or more natural manganese are estimated at 40,000 long tons in 1940 compared with 29,307 in 1939. Shipments in 1940 from domestic mines of ferruginous manganese ore containing 10 to 35 per cent. natural manganese are estimated at 306,000 long tons compared with 239,544 tons in the previous year, while shipments of ore containing 5 to 10 per cent. natural manganese from domestic mines are estimated at 984,000 long tons compared with 469,703. Imports for the various grades of manganese ore also showed an increase in 1940 compared with 1939. The chief importers into the United States for the year 1940 were the Union of South Africa, Brazil, Gold Coast, British India, and Cuba.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for errors that may occur.

Mortgages and Charges

(Note.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every company shall, in making its Annual Summary, specify the total amount of debt due from the company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.)

BAILEY'S FERTILIZERS, LTD., London, E.C. (M., 5/4/41). February 24, £3000 secured loan notes; general charge.

BITUMINOUS COMPOSITIONS, LTD., Grimsby. (M., 5/4/41). March 10, £6500 charge, to Wellow Motor & Finance Co., Ltd.; charged on premises forming part of Calder Mills, Portobello Road, Wakefield. *£7632. February 2, 1940.

BUCKLAND SAND & SILICA CO., LTD., Reigate. (M., 5/4/41). March 6, £5000 debentures; general charge. *£5000 debentures. October 4, 1940.

Satisfactions

BRITISH GAS PURIFYING MATERIALS CO., LTD., Leicester. (M.S., 5/4/41). Satisfaction March 12, of debentures registered May 18, 1935.

DE PASS FERTILIZERS, LTD., Barking. (M.S., 5/4/41). Satisfaction March 11, of debentures registered December 22, 1933.

County Court Judgments

B.B. TECHNICAL LABORATORIES, LTD., R/O, c/o 1-4, Warwick Street, W.1. (C.C.J., 5/4/41). Manufacturing chemists, £26 1s. 6d., January 7.

Companies Winding-Up Voluntarily

STRUCTURAL PLASTIC MOULDERS, LTD. (C.W.U.V., 5/4/41). R. H. Kidd, 86 St. Vincent Street, Glasgow, liquidator.

LEYTON MANUFACTURING CO., LTD. (C.W.U.V., 5/4/41). By special resolution, March 20. Mr. Donald Ross, of Messrs. Finnie Ross Welch & Co., 108a Cannon Street, London, E.C., appointed liquidator.

Company News

The British Xylonite Co., Ltd., have declared a final dividend at 7½ per cent., making 10 per cent. for the year (same).

Anglo-Greek Magnesite Co., Ltd., have announced a final dividend on ordinary of 5 per cent., making 8 per cent. for year (same).

A. Boake Roberts & Co., Ltd., have declared an interim dividend of 1½ per cent., tax free (same).

Reginald Maurice, Ltd., manufacturers of chemicals, etc., have changed their name to **R. A. Clements (London), Ltd.**, on March 10.

Hadfields, Ltd., have declared a final dividend of 15 per cent., less tax, on the ordinary stock, making 22½ per cent., less tax, for the year.

The Ruberoid Co., Ltd., announces a trading profit for 1940 of £118,086 (£133,018), and has declared a final dividend of 6 per cent., making 8 per cent. (9 per cent.).

Chinnor Cement and Lime Co., Ltd., announce a trading profit for 1940 of £66,240 (£64,545), and have declared a final dividend of 7½ per cent., making 10 per cent., less tax, for year (same).

Stewarts & Lloyds, Ltd., are maintaining a dividend of 12½ per cent. on deferred stocks, payable about May 24, less tax, at the rate then ruling. The annual report is to be issued about May 9.

Tunnel Asbestos Cement Co., Ltd., have declared an interim dividend of 15 per cent. on ordinary shares (last year 10 per cent.), and 10 per cent. on deferred shares (last year 5 per cent.), both less tax.

Wood Impregnation, Ltd., 9 Cavendish Square, W.1., have increased their nominal capital beyond the registered capital of £1000 by the addition of £5900, divided into 450 "A," 50 "B" and 5400 "C," shares of £1 each.

Lovering China Clays, Ltd., announce interest on 6 per cent. debenture shares of 3 per cent. for half-year ended March 31, 1940, and 1½ per cent. on account of half-year ended September 30, 1940, together with penal interest at the rate of 6 per cent. per annum.

The Rugby Portland Cement Co., Ltd., announce a net profit of £73,364 (£80,305), depreciation having been increased from £40,263 to £49,217. The ordinary dividend is maintained at 7½ per cent., and £57,930 goes forward (against £50,636).

Booths Chemists (London), Ltd., have increased their nominal capital beyond the registered capital of £1000 by the addition of £1000, which is divided into 1000 6 per cent. cumulative preference shares of £1 each.

The International Paint & Compositions Co., Ltd., announce a net profit for 1940 of £208,145 (£208,823), and have declared a final dividend of 16 per cent. on ordinary shares, making 20 per cent. for the year (same).

The National Gas & Oil Engine Co., Ltd., announces a profit of £64,548 (£32,786), and is paying a dividend of 5 per cent., less tax (2½ per cent.).

Agricultural and Chemical Products, Ltd., 32 Bishopsgate, E.C.2., have increased their nominal capital beyond the registered capital of £1000 by the addition of £1000 in £1 ordinary shares.

British Oil & Cake Mills, Ltd.—a member of the Lever Brothers and Unilever Group—report a net profit of £745,373, last year £735,063), an ordinary dividend of 9 per cent. (same), and a preferred ordinary dividend of 12½ per cent. (same). The amount allowed for tax was £53,415 (£50,232), and a new reserve for war damage contributions was placed at £34,500. £77,054 is carried forward, against £76,179. Meeting, Unilever House, E.C.4, April 10, at 2 p.m.

New Companies Registered

British Sako Products, Ltd. (366,076). Private company. Capital £100 in 100 shares of £1 each. Manufacturers of and dealers in chemical products, etc. Subscribers: Geo. S. Sale, 58 Eaton Place, S.W.1., Frank H. Curtis. Solicitors: Neve Beck and Crane, 21 Lime Street, E.C.3.

Chemical and Allied Stocks and Shares

THE favourable nature of the war news produced firmer conditions in most sections of the Stock Exchange earlier in the week, but the near approach of the Budget continued to govern market sentiment, and very little improvement in the volume of business was reported. Chief attention continued to centre on investment stocks, under the lead of 3½ per cent. War Loan, which was again higher on balance. Among industrial securities, those of companies engaged in essential war work were inclined to be firmer, more particularly in cases where the average profits in the immediate pre-war years were low, because these concerns would benefit if the basis on which E.P.T. is calculated were made less inequitable.

There was again a fair amount of activity in Imperial Chemical, which, however, at 30s. were virtually the same as a week ago, but the 7 per cent. preference units improved from 32s. 4½d. to 32s. 9d. Borax Consolidated deferred attracted some attention (as did the shares of various other companies with important interests in the U.S.A.), and on balance have improved from 27s. 9d. to 29s., while slightly higher prices also ruled for the preferred and preference units. Moreover, Dunlop Rubber appreciated to 33s. 9d. on hopes that it may be possible to keep the distribution at the same rate as that for 1939, sentiment having been assisted by the recently-issued statement of British Tyre & Rubber which, it may be recalled, showed the maintenance of the dividend and bonus at 11 per cent. The shares of the latter company were firm at 40s. 9d.xd. Lever & Unilever remained around 22s. 6d., and the company's various classes of preference shares were also steady, while British Oil & Cake Mills preferred ordinary further improved from 37s. to 37s. 6d. British Oxygen were steady at 63s. 9d.xd, the 15 per cent. dividend being regarded as a good achievement, bearing in mind the larger capital in issue. Turner & Newall again changed hands quite actively, but at 68s. 9d. lost part of the rise shown last week. Monsanto Chemicals 5½ per cent. preference shares remained at 22s. 6d., and continued to be firmly held, the recently-issued results having shown the good cover for the dividend requirements of this class of capital. Elsewhere, Nairn & Greenwich lost an earlier improvement, but at 52s. 6d. were unchanged on balance for the week, while Barry & Staines were 6d. better at 26s. 6d. The ordinary units of the Distillers Co. were steadier at 60s. 9d., and United Molasses transferred around 23s. 6d.

Fairly active dealings were again reported in British Plaster Board 5s. ordinary, which were around 13s. 3d. Moreover, Associated Cement were better at 54s. 7½d., awaiting the full results. Stewarts & Lloyds improved to 43s., and United Steel to 20s. 9d., the developments indicating a close working agreement between the two companies. Few movements of importance were shown in Dorman Long, Consett Iron, and other iron and steel securities. Tube investments were 90s., and Staveley ordinary 45s. 9d., while Richard Thomas issues were reported to be firmer, although prices were virtually the same as a week ago. United Glass Bottle changed hands up to 52s., pending the dividend announcement, and Canning Town Glass 5s. shares transferred at slightly over 4s. Wall Paper Manufacturers' deferred units were better at 20s. 3d. and, compared with a week ago, Pinchin Johnson were unchanged at 17s. 9d., but International Paint moved up from 81s. 3d. to 82s. 6d. Consideration of the statements at the recent meeting maintained firmness in Courtaulds, which at 30s. 9d. were slightly better, but few movements were shown in British Celanese and other textile shares. In other directions, Boots Drug 5s. ordinary were 34s. 9d., Sangers 15s. 6d., and Timothy Whites 18s. Oil shares had a firmer appearance; "Shell" were better on balance and, awaiting the interim dividend announcement, Trinidad Leaseholds recorded a small improvement.